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Reconstruction and masticatory rehabilitation of a bilateral maxillary defect with a microvascular free fibula flap

Abstract: Microvascular free flaps are frequently applied in midfacial reconstruction to restore mastication and functional dentition in addition to aesthetic and contour rehabilitation. Especially bilateral maxillectomy defects are multidimensional and result in quality of life deterioration and long-term impairment if not reconstructed properly. Therefore, computer-aided three-dimensional surgical planning can help to achieve not only an adequate implant-fixed dentition but also proper soft tissue conditions in the palate and alveolar ridge. In this case presentation a 70-year-old lady after multiple cancer resections in the maxilla received a fibula free flap bilateral maxillary reconstruction including palatal coverage via a perforator perfused skin flap and implant-based dental rehabilitation. Additionally, vestibuloplasty was performed to restore proper lip contours and increase lip function. A one-stage, three-dimensional planned microvascular fibula free flap reconstruction after cancer resection in combination with postoperative implant placement and vestibuloplasty is a clinically valuable treatment concept even in older patients to restore function and facial contours.

Keywords: maxilla reconstruction; vestibulopasty; oscc; fibula grafting

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Introduction

Midfacial reconstructions of bony and soft tissue defects are challenging in terms of achieving acceptable aesthetic and functional results [15]. Especially the replacement of larger, two-sided maxillary defects after cancer ablation or major trauma can be a sophisticated operative procedure when a separation of the nasal and oral cavity together with a restoration of the maxillary buttresses, functional dentition and mastication with aesthetic midfacial contours is required [8]. There are several options for maxillary defect reconstruction, like maxillary prostheses, pedicle flaps and free flaps. Compared to mandibula reconstruction, there are fewer reports and publications on maxillary free flap restorations and only a few of these papers report on free flaps applied for rehabilitation after subtotal or even total maxillectomy.

Considering the complexity of defects after subtotal maxillectomy, the sagittal, transversal and axial dimension of both the soft and hard tissue of free flaps is of major importance. During preoperative planning major attention should be turned to an optimal implant-fixed dental restoration in combination with adequate speech and swallowing as well as nasal cavity and maxillary sinus reconstruction. In this situation, 3D virtual planning for osteomyocutaneous free flaps is a very useful tool [9]. Additionally, individually prefabricated osteosynthesis materials enable fixation of the bone blocks of free flaps according to the preoperative planning. This aspect is of major importance to ensure proper mandibula-maxilla relations in order to achieve adequate dental and masticatory function.

Numerous free flaps have been used for maxilla reconstruction (e.g. scapula, radial, iliac crest and rib) [11]. However, focusing on larger, bilateral defects, free fibula flaps (FFF) are most frequently applied because of a relatively long flap pedicle, adequate bone dimensions for postoperative dental implant placement and the possibility to add one or two perforator perfused skin islands for palatal restoration if needed.

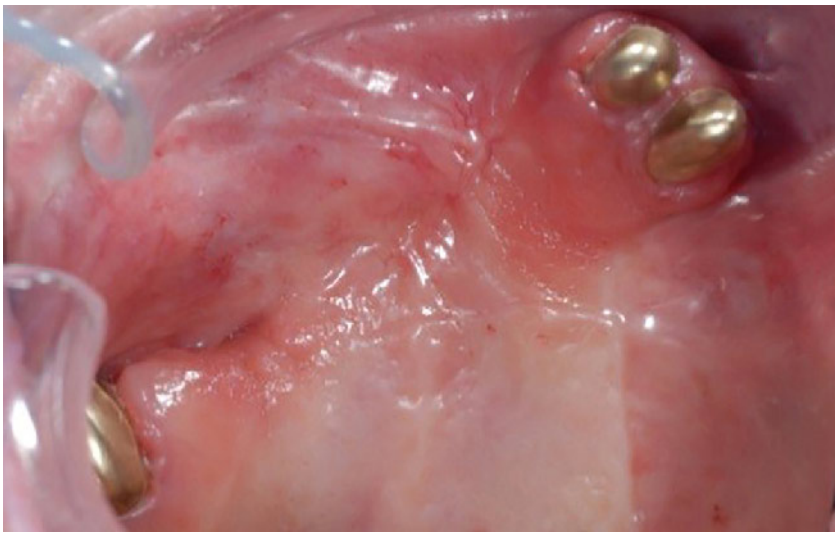

Figure 1 Partially edentulous maxilla with missing vestibule in region 15–22

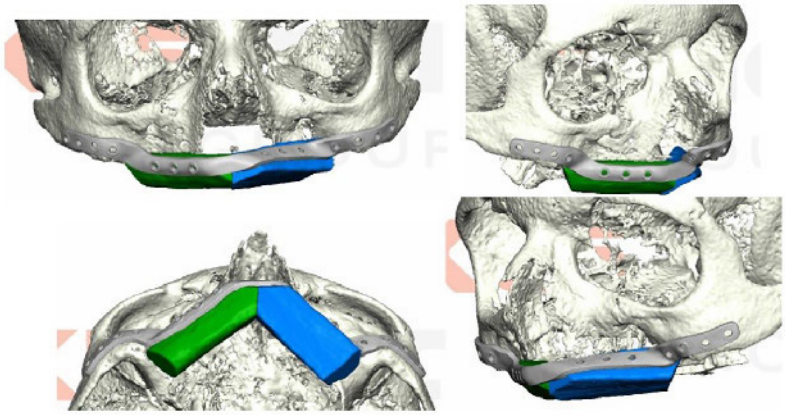

Figure 2 Virtual planning of CAD/CAM fibula bone transplant in the upper jaw.

In this article a case of a 72-year-old lady after multiple cancer resections in the maxilla with consecutive free flap reconstruction and dental restoration based on preoperative 3D planning and a patient-specific implant (PSI) is presented.

Case history

The patient has been undergoing treatment at the Oral and Maxillofacial Surgery Clinic in Erlangen since 2001. In this year (2001) an oral squamous cell carcinoma (OSCC) was diagnosed in the maxilla which was treated curatively with surgery and radio- and chemotherapy. In 2006 the patient was diagnosed with a recurrent cancer in the upper jaw which was again treated surgically and adjuvantly with radio- and chemotherapy.

After the removal of most of the remaining maxillary teeth (with progressive radiation damage) and iliac crest augmentation by the Oral and Maxillofacial Surgery Clinic, the patient was rehabilitated with dental implants by her general dentist in 2017. In April 2018 she presented herself for follow-up care and with a renewed desire for reconstruction, since the implants were gradually lost with insufficiently healed iliac crest and she currently had no dental prosthesis in the upper jaw (as seen in Figure 1).

After diagnostics using CT angiography of the neck and pelvis/legs, the decision was made together with the patient to perform a CAD/CAM fibula reconstruction from the right side as shown in Figure 2.

In May 2018 the operation was performed under intubation general

Figure 3 Postoperative panoramic X-Ray after fibula reconstruction.

Figure 4 Postoperative panoramix x-ray after insertion of implants. The osteosynthesis material will be left.

anesthesia. In the course of the reconstruction, a biopsy was taken in region 13, which again revealed squamous cell carcinoma. Within the operative procedure the cancer, including major parts of the hard palate, were removed and reconstructed via a perforator perfused skin island taken together with the free fibula flap. The definitive histology was pT1, L0, V0, Pn0, G1, R0, so that the interdisciplinary tumor board decided on aftercare after total cancer removal. The patient could be discharged from hospital after 16 days and was placed in outpatient care. The postoperative bony situation is illustrated in Figure 3 in the form of a panoramic X-ray.

In November 2018, implants in region 22, 24, 12 and 14 (Straumann BL RC 4.1 mm × 12 mm) were inserted with primary stability in sufficient wound conditions and regularly healed bone graft (as seen in Figure 4). The patient received Amoxiclav 875/125 mg perioperatively twice daily per oral and metamizole 500 mg if required.

As the vestibule was missing after microvascular reconstruction, a vestibuloplasty using Mucograft (Geistlich Biomaterials GmbH, Baden-Baden, Germany) was performed during the exposure of implants in March 2019. The implants were regularly osseointegrated. In the case of severe scar tractions in the frequently pre-operated and irradiated area, a bandage plate was made using an intraoperative alginate impression to secure the vestibuloplasty. This was fixed using the 4 healings (Straumann BL RC, H: 6mm) with light-curing composite (Tetric flow A1, Ivoclar Vivadent, Schaan, Liechtenstein). The patient presented herself regularly to the outpatient clinic of the Oral and Maxillofacial Surgery Clinic for wound monitoring and cleaning of the plate (see Figure 5 and 6).

In June 2019, the patient was finally treated prosthetically with a removable bar-implant-supported denture in the Prosthetic Dental Clinic of the University of Erlangen-Nuremberg as illustrated in Figure 7. The last tumor follow-up in August 2019 showed no clinical or CT-graphical evidence of recurrence.

Discussion

For bilateral maxillary bony and soft tissue defect reconstruction the FFF in combination with a preoperative computer-aided planning and prefabricated osteosynthesis is a very useful tool. Although obturator prostheses are still a successful treatment strategy, there are recurrent problems with cleaning and leakage. The current literature reports of high patient satisfaction in terms of mastication, speech and swallowing as well as aesthetics after implant-based dental rehabilitation in combination with free flap reconstructions [16]. After previous cancer-related radiotherapy in the head and neck area, swallowing is impaired due to reduced tongue mobility and scar formation. Additionally, the enoral mucosa is intolerant for mechanical loading and the underlying jaw bone is prone to developing osteonecrosis in the event of local mucosal inflammation. Composite free flaps containing soft and hard tissue components enable implant-based dental rehabilitation and at the same time provide palatinal soft tissue coverage. In patients who

Figure 5a–c Interaoperative situation of the vestibuloplasty with mucograft **(a)** and fixation of the woundplate above the healing abutments **(b, c)**.

Figure 6 a and b (from left to right). Postoperative situation of vestibuloplasty, after 7 days **(a),** and after 17 days **(b).**

(Fig. 1–7: M. Buchbender)

Figure 7 Inserted prosthesis.

require total maxilla reconstruction after radiotherapy and/or previous free flap surgery, the pedicle length of the flap is of great importance, as closely located vessels like the facial artery and vein might not be present.

Some authors favor the deep circumflex iliac artery free flap (DCIA) for midfacial reconstruction because of relatively large bone dimensions and a flexible soft tissue component for oral cavity and maxillary sinus coverage. However, when planning bilateral defect reconstruction in combination with a reliable skin coverage the DCIA has to be chosen with caution [17]. Most authors prefer FFFs for a one-stage bony and soft tissue bilateral maxilla reconstruction, as presented in this analysis [5, 7, 8]. If immediate reconstruction of maxillary defects after cancer resection is planned, a special emphasis should be laid on resection margins according to preoperative imaging techniques. As the status of positive margins plays a crucial role in the treatment of oral squamous cell carcinoma (OSCC), precise and dedicated planning is necessary to successfully achieve a one-stage bilateral bony and soft tissue maxilla reconstruction suitable for dental and masticatory rehabilitation.

For smaller and unilateral defects, local flaps like the nasolabial flap from the cheek or temporal muscle flaps are also reliable options in terms of soft tissue reconstruction or closure of postoperative fistulas surrounded by scarred tissue [3, 4]. If needed, these flaps can be combined with non-vascularized bone grafts in order to achieve implant-based dental rehabilitation [6].

Zygomatic-anchored implants are another option for the fixation of functional dentition after resection of maxillary bone structures in some cases [14]. Operative implant placement into the zygomatic bone is a feasible and technically sophisticated procedure as the orbita and the maxillary sinus are situated nearby. Local infections, nerve injury or even vision impairment are significant problems which can be associated with this type of implant [2]. Additionally, the status of soft tissue coverage of the maxillary defects and the peri-implant keratinized mucosa is closely related to long-term stability and peri-implant health [1]. Especially in patients with strongly changed anatomical conditions, as in this case after bone and soft tissue reconstruction, a vestibule and thus also keratinized tissue is completely missing. In this case vestibuloplastic surgery is indicated, but is also a major operative challenge.

Especially the preparation and preservation of the neo-vestibulum can be difficult due to increased scar retractions in areas that have been frequently operated and in some cases even previously irradiated. To handle this problem, one possibility is the use of wound plates (in the sense of acrylic splints), which are designed to hold off the soft tissues without applying pressure to the grafts (regardless of whether autologous or not), but with slight pressure to the caudal or ventral side so that the graft can heal without recurrence by traction of soft tissue [12]. In the edentulous jaw, plate retention can be ensured by fixation with light-curing composite via the healing abutments. However, it must be ensured that the plate or wound is checked regularly, as excessive pressure on tissue via the plate itself or the composite can lead to undesired reactions, e.g. infections or severe pain [10].

After cancer ablation and previous or planned radiotherapy this reconstructive method should be critically investigated during the planning period if the patient's condition is suitable.

Especially after radiotherapy, peri-implantitis and finally implant loss is still an unsolved problem in some cases [13]. A sufficient amount of keratinized mucosa around dental implants inserted into the transferred bone seems to be very important here.

Conflicts of interest:

The authors declare that there is no conflict of interest within the meaning of the guidelines of the International Committee of Medical Journal Editors.

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(Photo: Markus Kohler)

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